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Two New Species of *Cyrtodactylus* (Squamata: Gekkonidae) from Myanmar

by

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Two new species of the gekkonid lizard genus *Cyrtodactylus* are described on the basis of material collected in Popa Mountain Park and Alaungdaw Kathapa National Park in north central Myanmar. The species from Popa Mountain is highly distinctive and resembles members of the Indian-Sri Lankan subgenus *Geckoella* in external appearance. It is characterized by its short digits, large number of midventral scales, series of 8 precloacal pores and absence of precloacal groove, femoral pores and enlarged femoral scales. The larger species, from Alaungdaw Kathapa, is diagnosed by its long digits and tail, absence of precloacal groove, series of 9–11 precloacal pores separated from a series of 11–12 femoral pores on each side, enlarged subcaudal plates, and pattern of 6–8 pairs of more-or-less well-defined, dark dorsal blotches between the nape and sacrum. The larger of the two species may be allied to *C. consobrinus* and other large-bodied southeast Asian members of the genus. The gekkonid fauna of Myanmar is more diverse than previously recognized and includes as many as 12 species of *Cyrtodactylus*.

Both the tropical and temperate parts of Eurasia are occupied by gekkonid lizards that lack expanded toe pads and are characterized by a "bent-toed" appearance. The taxonomic history of these geckos is complex. Prior to the work of Underwood (1954) these taxa were typically lumped, along with other padless geckos, into the genus *Gymnodactylus*. Underwood (1954) restricted this name to South American forms, resurrecting *Cyrtodactylus* Gray for Old World taxa. Palearctic bent-toed geckos have subsequently been revised by Szczerbak and Golubev (1977, 1984, 1986), who demonstrated that fundamental differences exist between these taxa and tropical Asian *Cyrtodactylus*. The nomenclature of this group has been problematic (Kluge 1985; Mees 1987) and robust phylogenetic hypotheses at both the inter- and intrageneric levels are lacking. Kluge (1991, 1993, 2001) recognized two genera of tropical Asian bent-toed geckos: *Geckoella*, occurring in Peninsular India and Sri Lanka, and *Cyrtodactylus*, distributed from south Asia to the western Pacific, as far as the Solomon Islands. Generic composition in *Cyrtodactylus* has remained unstable, chiefly with respect to certain taxa occurring in northern India and adjacent regions (e.g., Kluge 1993, 2001; Bauer and Henle 1994; Khan and Rösler 1999; Rösler 2000; Wells 2002). Rösler (2000) placed all Palearctic taxa of questionable affinities (including *Gonydactyluys martinstollii* Darevsky et al., 1997, *G. markuscombaii* Darevsky et al., 1997, and *G. nepalensis* Schleich and Kästle, 1998) in the genus *Cyrtopodion*, but regarded *Geckoella* as a subgenus of *Cyrtodactylus*. Under this interpretation 63 species of *Cyrtodactylus* are currently recognized [Rösler 2000, 2001; Das and Lim 2000; Wells 2002; *Cyrtodactylus mansarulus* Duda and Sahi, 1978, although treated by Rösler (2000) as a *Cyrtodactylus*, is probably correctly assigned to *Cyrtopodion* sensu lato]. Numerous additional un-

described taxa are known to exist (Bauer and Henle 1994; R. Günther, pers. comm.), making *Cyrtodactylus* one of the most speciose of all gecko genera.

Smith (1935) recorded six species of *Cyrtodactylus* from Burma: *C. feae*, *C. consobrinoides*, *C. khasiensis*, *C. variegatus*, *C. oldhami*, and *C. peguensis*. Hundley (1964) listed seven species, omitting *C. feae* but including one species referable to *Cnemaspis*. He also added *C. rubidus*, an Andaman Islands endemic to the fauna, presumably on the basis of material from the Cocos Group, the only part of the Andamans under the administration of Myanmar. Das (1997) and Das and Lim (2000) also indicated the occurrence of *C. pulchellus* from the country. I here describe two hitherto unknown members of the genus collected by the Myanmar Herpetofaunal Survey in the Sagaing and Mandalay Divisions of north central Myanmar.

Materials and Methods

The following measurements were taken with Brown and Sharpe Digit-cal Plus digital calipers (to the nearest 0.1 mm): snout-vent length (SVL; from tip of snout to vent), trunk length (TrunkL; distance from axilla to groin measured from posterior edge of forelimb insertion to anterior edge of hindlimb insertion), crus length (CrusL; from base of heel to knee); tail length (TailL; from vent to tip of tail), tail width (TailW; measured at widest point of tail); head length (HeadL; distance between retroarticular process of jaw and snout-tip), head width (HeadW; maximum width of head), head height (HeadH; maximum height of head, from occiput to underside of jaws), ear length (EarL; longest dimension of ear); forearm length (ForeaL; from base of palm to elbow); orbital diameter (OrbD; greatest diameter of orbit), nares to eye distance (NarEye; distance between anteriormost point of eye and nostril), snout to eye distance (SnEye; distance between anteriormost point of eye and tip of snout), eye to ear distance (EyeEar; distance from anterior edge of ear opening to posterior corner of eye), internarial distance (Internar; distance between nares), and interorbital distance (Interorb; shortest distance between left and right supraciliary scale rows).

Scale counts and external observations of morphology were made using a Nikon SMZ-10 dissecting microscope. Radiographic observations were made using a Faxitron closed cabinet X-ray system. Comparisons were made with museum material in the collections of the California Academy of Sciences (CAS), United States National Museum (USNM), and the Museum of Comparative Zoology (MCZ), as well as original published descriptions and descriptions provided in broader faunal and taxonomic treatments (e.g., Smith 1935; Szczerbak and Golubev 1986; Hikida 1990; Ulber 1993; Darevsky and Szczerbak 1997; Das 1997; Das and Lim 2000).

Geographic coordinates were recorded by the original collectors from a Garmin 12 GPS (datum WGS 84).

Systematics

Reptilia: Squamata: Gekkonidae

***Cyrtodactylus brevidactylus*, sp. nov.**
Figs. 1, 2

Holotype. — CAS 214104 (Field number JBS 4210), adult male; Popa Mountain Park, Kyauk Pan Tawn Township, Mandalay Division, Myanmar (20°57′56.8″N, 95°14′18.8″E); collected by Htun Win, Thin Thin, Sai Wunna Kyi and Hla Tun, 26 March 2000.

Paratypes. — CAS 214105 (Field number JBS 4211), adult female; data as for holotype. CAS 214120 (Field number JBS 4231), adult female; Popa Mountain Park, Kyauk Pan Tawn Township,

Mandalay Division, Myanmar (20°59′00.2″N, 95°16′12.8″E); collected by Htun Win, Thin Thin, San Lwin Oo, Sai Wunna Kyi and Hla Tun, 27 March 2000.

ETYMOLOGY. — From the Latin *brevis*, short, and the latinized Greek *dactylus*, finger, in recognition of the very short digits of this species. The epithet is an adjective in the nominative singular.

DEFINITION. — A moderately sized *Cyrtodactylus*, snout-vent length 71–88 mm; body robust, limbs, and especially digits, short; two pairs of enlarged postmental scales, members of each pair in broad contact with one another; dorsal scales consisting of 27 rows of enlarged keeled tubercles, each surrounded by smaller, conical scales, yielding a very rugose appearance; 45 ventral scales between lowest rows of enlarged flank tubercles; no precloacal groove, 8 precloacal pores in a single series in both males and females, no femoral pores or enlarged femoral scales. Eleven subdigital lamellae beneath 4th toe of pes distal to digital inflection. Subcaudal scalation (based on original portion of holotype tail) uniform and granular, without enlarged midventral plates. Dorsal pattern of 3–4 large dark dorsal blotches between nape and sacrum. Head chocolate brown with white markings, including a Y-shaped mark on the nasal, frontal and parietal surfaces.

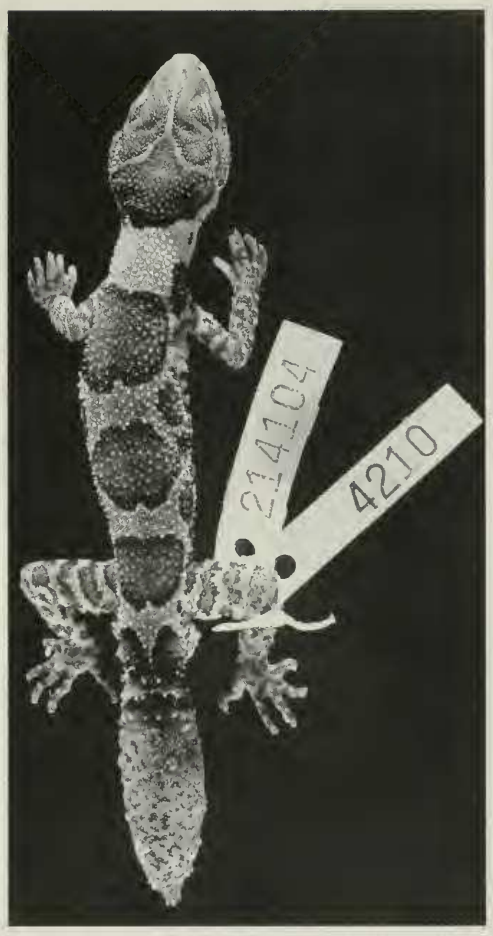

FIGURE 1. Holotype of *Cyrtodactylus brevidactylus*, sp. nov. (CAS 214104) from Popa Mountain Park, Myanmar. Note the short, stout regenerated tail; short, strongly kinked digits; and Y-shaped pattern on the head.

DESCRIPTION (based on holotype, CAS 214104). — Adult male with midventral incision from tissue removal. Snout-vent length 71.4 mm. Head short (HeadL/SVL ratio 0.20), relatively wide (HeadW/HeadL ratio 0.64), not depressed (HeadH/HL ratio 0.39), distinct from neck. Lores and interorbital region inflated, canthus rostralis prominent. Snout short (SnEye/HeadL ratio 0.34); longer than eye diameter (OrbD/SnEye ratio 0.61); scales on snout and forehead rounded, granular, becoming heterogeneous posteriorly; scales on snout smaller than those on occipital region. Eye relatively small (OrbD/HeadL ratio 0.20); pupil vertical with crenelated margins; supraciliaries short, conical. Ear opening oval, relatively large (EarL/HeadL ratio 0.05); greatest diameter vertical; eye to ear distance greater than diameter of eyes (EyeEar/OrbD ratio 1.25). Rostral approximately 2/3 deep (2.0 mm) as wide (3.0 mm), incompletely divided dorsally by weakly developed rostral groove; two enlarged supranasals separated by a single, roughly pentagonal internasal; rostral in contact with supralabial I, supranasals, and internasal; nostrils oval, each surrounded by supranasal, rostral, first supralabial, enlarged postnasal and narrow crescentic nasal; nasal in turn bordered by three small postnasal scales; two rows of scales separate orbit from supralabials. Mental subtriangular, much wider (3.2 mm) than deep (1.8 mm); two pairs of enlarged postmentals, anteriormost approximately 3–4 times larger than posterior, posterior approximately 3–5 times larger than adjacent chinshields; each anterior postmental bordered anteriorly by mental, medially by other anterior postmental, laterally by first infralabial, and posteriorly by an enlarged lat-

FIGURE 2. Living specimen of *Cyrtodactylus brevidactylus*, sp. nov. (CAS 214120, paratype) from Popa Mountain Park, Myanmar. Photo by Hla Tun.

eral chinshield, a small granule, and posterior postmental; posterior postmentals each bordered laterally and posteriorly by series of 5–6 granules. Infralabials bordered by a row of scales slightly larger than more posterior throat granules. Supralabials (to midorbital position) 8 (right)–10 (left); supralabials to angle of jaws 11 (right)–12 (left); infralabials 11; interorbital scale rows across narrowest point of frontal 17.

Body stout, elongate (TrunkL/SVL ratio 0.40) with very weakly developed, non-denticulate ventrolateral folds. Dorsal scales heterogeneous, conical; regularly arranged large tubercles extending from posterior border of orbits and temporal region on to back; each tubercle bearing ridges, the most prominent forming a keel on the anterior-facing surface; enlarged tubercles surrounded by rosettes of smaller conical scales of varying sizes, the largest being anterior to the tubercle; tubercles becoming smaller and less prominently ridged on flanks; largest tubercles in approximately 27 rows at midbody. Ventral scales smaller than dorsal, weakly conical, posteriorly oriented and subimbricate; somewhat larger on chest and in precloacal region than elsewhere; midbody scale rows across belly to lowest row of enlarged lateral tubercles 45; gular region with strongly heterogeneous scalation; larger conical scales among smaller, mostly rounded, granules. Precloacal pores in a single series of 8 with a narrow poreless scale separating two continuous rows of 4 on each side; lateralmost scales flanked by an enlarged, slightly dimpled scale; scale row immediately posterior to pores much enlarged, but without evidence of glands or pores. No femoral pores or enlarged femoral scales; no precloacal groove. Scales on palm and sole smooth, rounded; scales on dorsal aspects of limbs keeled, similar to dorsal scales, with larger, conical tubercles interspersed among smaller scales.

Fore and hindlimbs relatively short, stout; forearm short (ForeaL/SVL ratio 0.16); tibia short (CrusL/SVL ratio 0.18); digits very short, strongly inflected at basal interphalangeal joints, all bearing robust, slightly recurved claws; subdigital lamellae narrow, rounded, enlarging somewhat distally, without scansorial surfaces; scansors distal to raised circular scale at digital inflection and not including ventral claw sheath: 8-7-10-9-8 (manus), 6-9-11-11-10 (pes); median scales proximal to digital inflection not or only slightly larger than adjacent granules; interdigital webbing absent. Relative length of digits (manus; measurements in mm in parentheses): IV (4.78) > III (4.47) > II (4.24) > V (3.01) > I (2.80); (pes): IV (5.77) > V (5.11) > III (4.49) > II (3.74) > I (2.82).

Mostly regenerated tail short, very stout, constricted at base and with an abruptly narrowing tip; regenerated tail much shorter than snout-vent length (TailL/SVL ratio 0.48); original portion of tail

with transverse rows of enlarged, conical tubercles, regularly spaced with approximately 6 rows of smaller scales intervening; ventral scales more uniform in size, keeled and conical, but more rounded than dorsals. Regenerated portion of tail with more-or-less uniform, rounded, rugose scales; without tubercles; 4 (right) or 5 (left) enlarged, striated, conical postcloacal spurs on each side of tailbase.

Osteology. Frontal bone extremely wide, with very prominent supraorbital ridges. Parietal bones paired. Premaxillary teeth loci 11, approximately 40 teeth on each maxillary bone, 47 on each dentary. Phalangeal formulae 2-3-4-5-3 for manus and 2-3-4-5-4 for pes; basal phalanges of manus imbedded in tissue of palm. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 3.5 post pygal caudal vertebrae to point of regeneration (0.5 post-pygal vertebrae in both paratypes). Two pairs of cloacal bones present, medial pair crescentic, lateral pair nodular, lying beneath the raised cloacal spurs (cloacal bones lacking in female paratypes). Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color a pale grayish brown to white. Boldly marked with numerous chocolate brown markings, each outlined sequentially by a relatively thick, dark brown border and a much thinner, whitish border, the latter only about one scale width in thickness. Dorsum of head predominantly chocolate brown with a paler Y-shaped marking; base of Y extending posteriorly from a pale, irregular marking on intercanthal region, bifurcating behind orbits and angling laterally towards upper margin of ear to fuse with whitish region extending from the jaw to the nape and forelimb insertion. Another light line extends from supraciliary scales backward to join the transverse line above the ear. A diffuse, pale marking present at anteroventral margin of orbit. Labial scales white with chocolate brown markings.

Dorsum marked by a series of 3–4 large, roughly symmetrical blotches between the nape and sacrum. A similar marking, but consisting of separate left and right blotches, on tail base. Lateral surface with a series of spots, including three behind the ear, one over the scapular region, and one or more between the lateral borders of each of the enlarged dorsal blotches. Markings along the ventrolateral margin of the body narrow and sometimes barlike. Limbs marked dorsally by a series of dark transverse bars that extend onto the edges of the ventral surfaces. Venter cream white tinged by the light brown speckling of individual scales. Tail mottled gray-brown with darker irregular transverse markings.

Color in life essentially identical (Fig. 2).

VARIATION. — Comparative mensural data for the holotype and paratypes is presented in Table 1. Both paratypes similar to holotype in most respects except as noted. **CAS 214120**: Adult female with midventral incision from tissue removal. Three small internasal scales present; supralabial scales to midpoint of orbit 8, to angle of jaw 10 (right)–11 (left); infralabials 11. Distal portion of digit II, left manus missing. Number of lamellae distal to enlarged scale at metaphalangeal inflection 6-7-9-9-6 (manus), 8-9-11-10-11 (pes). Precloacal pores as in holotype; cloacal spurs 3–4, much smaller than in holotype. Regenerated tail rounded without tapered tip, almost uniform dark brown. Dorsal pattern similar to holotype but base color a darker pinkish brown and markings darker and bolder; dark markings on either side of tail base fused at midline to form a complete band. Light lines on head in this and second paratype partially disrupted in temporal region. Venter beige, more heavily pigmented than holotype; throat with scattered dark blotches. **CAS 214105**: Adult female. One internasal scale; supralabial scales to midpoint of orbit 8, to angle of jaw 10 (right)–11 (left); infralabials 10 (left)–11(right). Number of lamellae distal to enlarged scale at interphalangeal inflection 7-7-10-9-8 (manus), 8-9-11-10-10 (pes). Precloacal pores as in holotype; cloacal spurs 3–4, much smaller than in holotype. Light markings on head less well defined than in holotype, not continuous. An extra band anterior to sacral blotch formed from fusion of smaller dorsolateral spots. Postcloacal band and tail as in CAS 214120. Limbs more darkly pigmented than in holotype. Ventral coloration beige with scattered brown marks, forming faint reticulations on margins of throat.

TABLE 1. Mensural data for the type series of *Cyrtodactylus brevidactylus*, sp. nov. Abbreviations as in Materials and Methods, all measurements in mm.

	CAS 214104 holotype	CAS 214120 paratype	CAS 214105 paratype
Sex	male	female	female
SVL	71.4	88.0	84.3
ForeaL	11.5	12.9	13.3
CrusL	13.1	14.4	16.3
TailL (entire)	35.0	23.6	19.3
TailL (portion regenerated)	24.0	17.0	14.6
TailW	9.0	10.9	11.3
TrunkL	28.6	39.8	39.5
HeadL	20.2	22.8	24.0
HeadW	12.9	15.5	14.9
HeadH	7.8	9.5	10.5
OrbD	4.1	5.2	5.2
EyeEar	5.2	5.6	5.9
SnEye	6.8	8.0	8.2
NarEye	4.6	5.4	4.9
Interorb	7.5	9.0	9.7
EarL	1.1	1.3	1.3
Internar	1.8	2.6	1.9

COMPARISONS. — *Cyrtodactylus brevidactylus* may be distinguished from all congeners on the basis of its stout body, short digits, series of 8 precloacal pores and no precloacal groove, femoral pores or enlarged femoral scales, highly tuberculate dorsal scalation, and dorsal color pattern, including Y-shaped marking on dorsum of head. The condition of precloacal and femoral pores in males has traditionally been widely used to distinguish members of the genus *Cyrtodactylus* (e.g., Darevsky and Szczerbak 1997). On this basis *C. brevidactylus* may be distinguished from the following species by the absence of a precloacal groove: *C. annulatus* (Taylor, 1915), *C. cavernicolus* (Inger and King, 1961), *C. marmoratus* (Gray, 1831), *C. papuensis* (Brongersma, 1934), *C. philippinicus* (Steindachner, 1867), *C. pubisulcus* Inger, 1958, *C. pulchellus* Gray, 1827, *C. rubidus* (Blyth, 1860), *C. sadleiri* Wells and Wellington, 1984; from the following species by the absence of femoral pores and/or enlarged femoral scales: *C. abrae* Wells, 2002, *C. agusanensis* (Taylor, 1915), *C. angularis* (Smith, 1921), *C. baluensis* (Mocquard, 1890), *C. biordinis* Brown and McCoy, 1980, *C. brevipalmatus* (Smith, 1923), *C. condorensis* (Smith, 1920), *C. consobrinoides* (Annandale, 1905), *C. consobrinus* (Peters, 1871), *C. darmandvillei* (Weber, 1890), *C. derongo* Brown and Parker, 1973, *C. feae* (Boulenger, 1893), *C. fraenatus* (Günther, 1864), *C. fumosus* (Müller, 1895), *C. gubernatorius* (Annandale, 1913), *C. interdigitalis* Ulber, 1993, *C. intermedius* Smith, 1917, *C. irregularis* (Smith, 1921), *C. jarujini* Ulber, 1993, *C. lateralis* (Werner, 1896), *C. loriae* (Boulenger, 1898), *C. louisiadensis* (de Vis, 1892), *C. malcolmsmithi* (Constable, 1949), *C. mimikanus* (Boulenger, 1914), *C. novaeguineae* (Schlegel, 1844), *C. oldhami* (Theobald, 1876), *C. papilionoides* Ulber, 1993, *C. peguensis* (Boulenger, 1893), *C. quadrivirgatus* Taylor, 1962, *C. redimiculus* King, 1962; *C. sworderi* (Smith, 1925), *C. tiomanensis* Das and Lim, 2000, *C. tuberculatus* (Lucas and Frost, 1900), *C. variegatus* (Blyth, 1859), *C. wetariensis* (Dunn, 1927), and *C.* n. sp. Bauer, 2002 (this paper); from the following species by the presence of precloacal pores: *C. jellesmae* (Boulenger, 1897), *C. laevigatus* Darevsky, 1964, *C. paradoxus* (Darevsky and Szczerbak, 1997), *C. sermowaiensis* (de Rooij, 1915), and most members of the subgenus *Geckoella* [*C. collegalensis* (Beddome, 1870), *C. deccanensis* (Günther, 1864), *C. jeyporensis* (Beddome, 1877), *C. nebulosus* (Beddome, 1870), and *C. yakhuna* (Deraniyagala, 1945)]; and from *C.* (*G.*) *triedrus* (Günther, 1864)

by having 8 vs. 3–4 precloacal pores. In comparison with remaining congeners, the presence of two (vs. one) pairs of enlarged postmental scales distinguish the new species from *C. adleri* Das, 1997, *C. irianjayaensis* Rösler, 2001, and *C. malayanus* (de Rooij, 1915) and the broad contact of second postmentals (vs. wide separation by anterior postmentals) distinguish it from *C. elok* Dring, 1979, *C. ingeri* Hikida, 1990, *C. khasiensis* (Jerdon, 1870), *C. matsuii* Hikida, 1990, and *C. yoshii* Hikida, 1990.

Furthermore, in comparison to other species known from Myanmar, the approximately 45 midventral scale rows of *C. brevidactylus* is greater than the comparable scale counts recorded for all other species (data from Smith, 1935 and Das, 1997): *C. consobrinoides* (35), *C. feae* (35), *C. khasiensis* (30–40), *C. oldhami* (34–38), *C. peguensis* (34–38 fide Smith 1935; 32 fide Das 1997), *C. pulchellus* (35), *C. variegatus* (22), *C.* n. sp. (this paper) (27–32). Each of these species also has a somewhat depressed habitus and differs markedly in color pattern from the new species (longitudinal stripes in *C. oldhami*, cross bands in *C. consobrinoides, C. pulchellus*; more numerous dark markings in the remaining species).

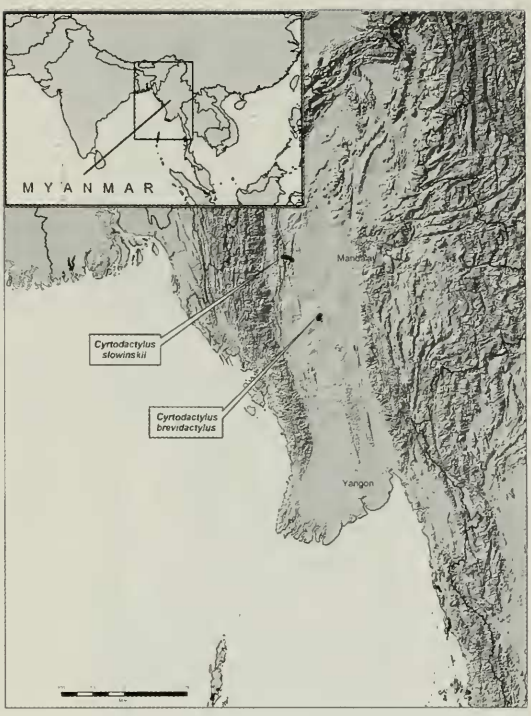

FIGURE 3. Map of Myanmar illustrating the distribution of *C. brevidactylus* and *C. slowinskii* in the central dry zone of the country. This region is bounded to the west by the Rakhine Yoma (Arakan Yoma) and to the east by the montane systems of Indochina. Map prepared by Michelle S. Koo, California Academy of Sciences.

DISTRIBUTION. — *Cyrtodactylus brevidactylus* is known only from Popa Mountain in the Mandalay Division of Myanmar (Fig. 3). The relative isolation of this physiographic feature suggests that the species may be a highly localized endemic, although further collecting in the central dry zone of Myanmar will be required to confirm this.

REPTILIA: SQUAMATA: GEKKONIDAE

***Cyrtodactylus slowinskii*, sp. nov.**
Figs. 4, 5

HOLOTYPE. — CAS 210214 (Field number JBS 2765), adult male; Sunthaik Chaung (tributary to Hkaungdin Chaung), Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°18′48.8″N, 94°24′29.0″E); collected by J. B. Slowinski, K. D. Wiseman, J. M. Lovette and J. V. Vindum, 11 July 1999.

PARATYPES. — CAS 210212–13, 210215–19 (Field numbers JBS 2739–40, 2766–70); data as for holotype. CAS 215474 (Field number JBS 6517); Thabake Say Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°19′06.6″N, 94°28′32.0″E); collected by Htun Win, Thin Thin, San Lwin Oo, and Sai Wunna Kyi, 26 May 2000. CAS 215593 (Field number JBS 6762); Thabake Say Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°18′29.4″N, 94°30′10.7″E); collected by Htun Win, Thin Thin, and San Lwin

FIGURE 4. Holotype of *Cyrtodactylus slowinskii*, sp. nov. (CAS 210214) from Alaungdaw Kathapa National Park, Myanmar. Note the relatively small dorsal tubercles, elongate digits, and pattern of paired dorsal markings.

Oo, 13 June 2000. CAS 215661 (Field number JBS 6965); Thabake Say Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°18′06.6″N, 94°28′32.0″E); collected by Htun Win, Thin Thin, San Lwin Oo, and Hla Tun, 29 June 2000. USNM 548141 (Field number JBS 6513), USNM 548142 (Field number JBS 6517); Swun Theik Camp, base of pine mountain, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°18′50.1″N, 94°24′25.7″E); collected by Htun Win, Thin Thin, San Lwin Oo, Sai Wunna Kyi, and Hla Tun, 30 May 2000. USNM 548143 (Field number JBS 6764); Thabake Say Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°18′29.4″N, 94°30′10.7″E); collected by Htun Win, Thin Thin, and San Lwin Oo, 13 June 2000.

ADDITIONAL MATERIAL (27 specimens). — All specimens from Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar. CAS 210110–11; Trail between Thabake Say Camp and Alaungdaw Kathapa Pagoda (22°19′10.0″N, 94°28′30.7″E); collected by J. B. Slowinski, K. D. Wiseman, J. M. Lovette, and J. V. Vindum, 6 July 1999. CAS 210205–11; data as for holotype. CAS 210220; locality and collectors for holotype, 11 July 1999. CAS 210250; Main road between Thabake Say Camp and Payawa Sakhan (Elephant Camp) (22°19′09.0″N, 94°28′45.6″E); collected by K. D. Wiseman, J. M. Lovette, and J. V. Vindum, 13 July 1999. CAS 210265; Left bank of Pwedon Chaung across from Payawa Sakhan (Elephant Camp) (22°19′20.4″N, 94°29′11.3″E); collected by J. B. Slowinski, K. D. Wiseman, J. M. Lovette, and J. V. Vindum, 13 July 1999. CAS 210292; Paya Chaung (22°18′54.7″N, 94°28′35.5″E); collected by K. D. Wiseman, J. M. Lovette, and J. V. Vindum, 15 July 1999. CAS 210293–95; Paya Chaung (22°18′52.9″N, 94°28′42.8″E); collected by K. D. Wiseman, J. M. Lovette, and J. V. Vindum, 15 July 1999. CAS 215483–92; Swun Theik Chaung, base of pine mountain (22°18′50.1″N, 94°24′25.7″E); collected by Htun Win, Thin Thin, San Lwin Oo, Sai Wunna Kyi, and Hla Tun, 30 May 2000. CAS 215711; Gon Nyin Bin (22°15′33.2″N, 94°36′09.6″E); collected by Htun Win, Thin Thin, San Lwin Oo, and Hla Tun, 4 July 2000.

ETYMOLOGY. — The specific epithet is a patronym honoring my late friend and colleague Joseph B. Slowinski, preeminent contributor to the herpetology of Myanmar. The epithet is a masculine noun in the genitive case.

DEFINITION. — A large sized *Cyrtodactylus*, snout-vent length to 108 mm; body relatively slender, digits long; one pair of enlarged postmental scales, in broad contact with one another; 19–22 rows of flattened, weakly-keeled tubercles; 27–32 ventral scales between weakly-developed ventrolateral folds; no precloacal groove, 9 precloacal pores (in holotype) in a single series in males only, 11 femo-

ral pores (in holotype) on each thigh, separated by a diastema from precloacal pores. Six widened subdigital lamellae beneath basal phalanx of 4th toe of pes, 13 narrow lamellae beneath more distal phalanges of same toes. Subcaudal scalation with single series of enlarged midventral plates. Dorsal pattern of 6–8 paired, dark, dorsal blotches between nape and sacrum; tail banded brown and white.

DESCRIPTION (based on holotype, CAS 210214). — Adult male, SVL 98.8 mm. Head moderately long (HeadL/SVL ratio 0.27), wide (HeadW/HeadL ratio 0.72), not depressed (HeadH/HeadL ratio 0.44), distinct from neck. Lores and interorbital region somewhat inflated, canthus rostralis not well developed. Snout short (SnEye/HeadL ratio 0.40); longer than eye diameter (OrbD/SnEye ratio 0.80); scales on snout and forehead rounded, granular, intermixed with small tubercles posteriorly; scales on snout much larger than those on occipital region. Eye relatively large (OrbD/HeadL ratio 0.32); pupil vertical with crenelated margins; supraciliaries short, blunt except for a few pointed scales at posterior border of orbit. Ear opening rounded, relatively large (EarL/HeadL ratio 0.08); eye to ear distance slightly greater than diameter of eyes (EyeEar/OrbD ratio 1.07). Rostral approximately 60% as deep (2.5 mm) as wide (4.2 mm), incompletely divided dorsally by weakly developed rostral groove; two enlarged supranasals separated by a single, smaller, roughly hexagonal internasal; rostral in contact with supralabial I, supranasals, and internasal; nostrils oval, laterally oriented, each in broad contact with rostral and also surrounded by supranasal, first supralabial, and a narrow crescentic nasal rim bordered by four postnasals; pigmented narial flap occludes posterior 2/3 of nostril; 4–5 rows of scales separate orbit from supralabials. Mental triangular, wider (4.5 mm) than deep (3.2 mm); one pair of enlarged postmentals, each approximately 40% size of mental; left and right postmentals in broad medial contact with no intervening granules, bordered laterally by first infralabial and an enlarged lateral chinshield, and posteriorly by 4–5 granular chin scales. Infralabials bordered by 1–3 rows of enlarged scales, largest anteriorly. Throat scales small, rounded, granular. Supralabials (to midorbital position) 8; enlarged supralabials to angle of jaws 10 (left)–11 (right); infralabials 9; interorbital scale rows across narrowest point of frontal bone 22.

Body moderately slender (TrunkL/SVL ratio 0.45) with very weakly developed, non-denticulate ventrolateral folds. Dorsal scales heterogeneous, mostly flattened granules with regularly arranged small, flattened, feebly-keeled tubercles extending from occipital region on to back and base of tail; tubercles most prominent on dorsolateral surfaces, somewhat smaller and flatter on nape, along middorsal line, and on flanks; tubercles in approximately 20 irregular longitudinal rows at midbody; 52 tubercles in paravertebral row from occiput to midsacrum . Ventral scales much larger than dorsal, cycloid, imbricate to subimbricate; largest under thighs and between precloacal pores and vent, somewhat larger on abdomen than chest; midbody scale rows across belly between ventrolateral folds 31; scales on throat minute, granular, grading into larger scales on chest. Precloacal pores in a single series of 9 with a narrow poreless scale separating two continuous rows of 4 (left) and 5 (right) pores; eleven femoral pores in a continuous row on each thigh, separated by 9 scales from distalmost precloacal pores; no precloacal groove. Scales on palm and sole smooth, flattened; scales on dorsal aspects of hindlimbs flattened, similar to dorsal scales, with larger, conical tubercles interspersed among smaller scales. Dorsal scales of forelimbs imbricate, without tubercles; scales of forearms heterogeneous with scattered tubercles, some keeled.

Fore and hindlimbs relatively short, stout; forearm short (ForeaL/SVL ratio 0.16); tibia short (CrusL/SVL ratio 0.18); digits long, strongly inflected at each joint, all bearing robust, recurved claws; subdigital lamellae widened beneath basal phalanx; lamellae from first proximal scansor greater than twice largest palm scale to first interphalangeal joint: 4-5-6-6-6 (manus) and 5-6-7-7-8 (pes); lamellae from first interphalangeal joint to toe tip, not including ventral claw sheath: 8-10-12-12-12 (manus) and 9-11-13-13-13 (pes); interdigital webbing present but weakly developed. Relative length of digits (manus; measurements in mm in parentheses): III (10.0) > IV (9.8) > II (9.1) > V (8.4) > I (6.6); (pes): V (12.0) > IV (11.2) > III (10.5) > II (8.7) > I (5.2).

Original tail long (TailL/SVL ratio 1.27), slender, slightly dorso-ventrally compressed. Scales arranged in regular whorls; dorsal scales rectangular. Six circumferential rows per whorl; each whorl with one row of 9 enlarged keeled tubercles, each tubercle separated from next by 0–2 smaller scales; caudal tubercles reduced or absent on distal 2/3 of tail; posteriormost caudal scales narrow and elongate. Subcaudal scales larger with a single median series of enlarged plates. Prominent cloacal spurs with 3 enlarged scales on each side of tail base.

Osteology. Frontal bone moderately wide. Parietal bones paired. Premaxillary teeth loci 11, approximately 48 teeth on each maxillary bone, 54 on each dentary. Phalangeal formulae 2-3-4-5-3 for manus and 2-3-4-5-4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 38 post pygal caudal in the complete original tail. One pair of robust, crescentic cloacal bones present, at level of second pygal vertebra. (cloacal bones lacking in female paratypes). Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color a medium brown marked by numerous chocolate brown patches, each with a dark brown border and a more peripheral, thin white line. Each marking bolder and more well-defined posteriorly and more diffuse anteriorly. Head with light lines forming a reticulated network between dark blotches. Occiput with three brown blotches (distinct in holotype but partially or entirely fused in some paratypes). A series of smaller, more-or-less symmetrical dark markings on top of head. Canthal region crossed by a pale, narrow transverse bar (faded in larger individuals, including holotype). A brown streak, bordered by cream white, running from behind orbit onto neck; 6–8 (usually 7, 7 in holotype) paired markings on dorsum from nape to sacrum, left and right sides often slightly out of phase. Markings on nape and sacrum generally oval, those between axilla and groin partly bifurcate posteriorly. A series of more diffuse brown markings on lateral surfaces. Limbs more-or-less strongly barred, with alternating light and dark markings extending on to digits. Tail base with elongate pair of dark marks similar to those on sacrum. Remainder of tail with alternating elongate dark bands and shorter pale interspaces; each interspace with a dark center; 12 dark bands, including tail tip, on original tail of holotype. Tail patterning extends on to venter, although bands less clearly demarcated. Venter cream white with scattered light pigment on most surfaces (males only). Palms and soles of feet dark in all specimens.

Color in life similar to that in preservative but with a slight yellowish cast to the white markings of the head and body (Fig. 5).

VARIATION. — Comparative mensural data for the holotype and paratypes are presented in Table 2. Paratypes similar to holotype in most respects except as noted. Scale rows between ventrolateral folds at midbody 27–32. Rows of dorsal tubercles at midbody 19–22. Precloacal pores 9–11, femoral pores 12 on each thigh in adult male paratypes (CAS 215474, 215661, USNM 548142). Females lacking precloacal and femoral pores and without enlarged or dimpled scales in this region; cloacal spurs present but weakly developed. CAS 210212, an adult female, contains two well-developed, shelled eggs, each with a maximum diameter of 12.6 mm. Juveniles (CAS 210215–19, 215593, USNM 548141, 548143) with incompletely ossified long bones. Tail broken in 3rd post-pygal vertebra in CAS 215661, 7th in USNM 548142, 18th in CAS 210215and 32nd in CAS 210212. All specimens with original tails with 38 post-pygal vertebrae. Color patterns varies in number of paired dark dorsal markings from 6 (CAS 210212) to 8 (CAS 210215, 215474), with all remaining specimens with seven pairs. Each pair of markings may be highly symmetrical (e.g., CAS 210216, USNM 548141) or largely out of phase (e.g., CAS 210217). Occipital markings distinct, as in holotype, or partially (CAS 210218, 215593, USNM 548142) or fully (CAS 210213, 210215, 210219, 215661, USNM 548143) fused. No significant differences in any features were noted among the additional 27 specimens examined.

COMPARISONS. — *Cyrtodactylus slowinskii* may be distinguished from all congeners on the basis of its relatively large size (to 108 mm SVL), long digits and tail, absence of precloacal groove, series of 9–11 precloacal pores separated from a series of 11–12 femoral pores on each side, enlarged

FIGURE 5. Living specimen of *Cyrtodactylus slowinskii*, sp. nov. (CAS 215483) from Alaungdaw Kathapa National Park, Myanmar. Photo by Hla Tun.

subcaudal plates, and pattern of 6–8 pairs of more-or-less well-defined, dark dorsal blotches between the nape and sacrum. *Cyrtodactylus slowinskii* may be distinguished from the following species by the absence of a precloacal groove: *C. annulatus* (Taylor, 1915), *C. cavernicolus* (Inger and King, 1961), *C. fumosus* (Müller, 1895), *C. marmoratus* (Gray, 1831), *C. papuensis* (Brongersma, 1934), *C. philippinicus* (Steindachner, 1867), *C. pubisulcus* Inger, 1958, *C. pulchellus* Gray, 1827, *C. rubidus* (Blyth, 1860), *C. sadleiri* Wells and Wellington, 1984; from the following species by the presence of precloacal pores: *C. jellesmae* (Boulenger, 1897), *C. laevigatus* Darevsky, 1964, *C. paradoxus* (Darevsky and Szczerbak, 1997), *C. sermowaiensis* (de Rooij, 1915), and most members of the subgenus *Geckoella* (*C. collegalensis* [Beddome, 1870], *C. deccanensis* [Günther, 1864], *C. jeyporensis* [Beddome, 1877], *C. nebulosus* [Beddome, 1870], and *C. yakhuna* [Deraniyagala, 1945]); from the following species by the presence of femoral pores: *C. adleri* Das, 1997, *C. angularis* (Smith, 1921), *C. brevidactylus* Bauer, 2002 (this paper), *C. elok* Dring, 1979, *C. fraenatus* (Günther, 1864), *C. ingeri* Hikida, 1990, *C. irianjayaensis* Rösler, 2001, *C. khasiensis* (Jerdon, 1870), *C. lateralis* (Werner, 1896), *C. malayanus* (de Rooij, 1915), *C. matsuii* Hikida, 1990, *C. papilionoides* Ulber, 1993, *C. peguensis* (Boulenger, 1893), *C. quadrivirgatus* Taylor, 1962, *C. sworderi* (Smith, 1925), *C. yoshii* Hikida, 1990, and *C.* (*G.*) *triedrus* (Günther, 1864); from *C. biordinis* Brown and McCoy, 1980 by having only a single row of femoral pores; from the following species by the presence of a diastema between precloacal and femoral pores: *C. abrae* Wells, 2002, *C. derongo* Brown and Parker, 1973, *C. jarujini* Ulber, 1993, *C. loriae* (Boulenger, 1898), *C. louisiadensis* (de Vis, 1892), *C. novaeguineae* (Schlegel, 1844), *C. tiomanensis* Das and Lim, 2000, *C. tuberculatus* (Lucas and Frost, 1900), and *C. variegatus* (Blyth, 1859); and from the following species by the presence of enlarged median subcaudal plates: *C. agusanensis* (Taylor, 1915), *C. brevipalmatus* (Smith, 1923), *C. gubernatorius* (Annandale, 1913), and *C. wetariensis* (Dunn, 1927). Of those species sharing with *C. slowinskii* similar precloacal and femoral pores and enlarged subcaudal plates, *C. baluensis* (Mocquard, 1890), *C. condorensis* (Smith, 1920), *C. consobrinoides* (Annandale, 1905), *C. consobrinus* (Peters, 1871), *C. darmandvillei* (Weber, 1890), *C. feae* (Boulenger, 1893), *C. interdigitalis* Ulber, 1993, *C. intermedius* Smith, 1917, *C. malcolmsmithi* (Constable, 1949), *C. mimikanus* (Boulenger, 1914), *C. oldhami* (Theobald, 1876), and *C. redimiculus* King, 1962 may be differentiated by their banded, striped, or spotted dorsal patterns, and all except *C. consobrinus* and *C. mimikanus* are much smaller (maximum SVL < 86 mm; Das 1997) than the new species. *Cyrtodactylus irregularis* (Smith, 1921) is

TABLE 2. Mensural data for the type series of *Cyrtodactylus slowinskii*, sp. nov. Abbreviations as in Materials and Methods, all measurements in mm. Note: CAS 210214 is the holotype, other specimens are paratypes. TailL **a** = original, **b** = broken, **c** = regenerated.

	CAS 210214	CAS 210212	CAS 210213	CAS 210215	CAS 210216	CAS 210217	CAS 210218	CAS 210219	CAS 215474	CAS 215593	CAS 215661	USNM 548141	USNM 548142	USNM 548143
Sex	male	female	female	female	female	male	female	male	male	female	male	female	male	female
SVL	98.8	96.7	104.7	66.6	72.1	83.3	79.8	79.8	107.8	61.0	101.3	65.3	106.5	61.7
ForeaL	14.5	15.3	16.0	10.2	10.4	13.0	12.6	12.4	15.8	9.2	14.3	9.4	15.4	8.9
CrusL	17.3	17.7	18.9	12.1	12.9	15.4	14.4	14.0	19.8	10.7	18.0	11.5	19.0	11.5
TailL	125.0**a**	108.0**b**	130.2**a**	43.6**b**	94.0**a**	86.0**a**	94.9**a**	88.3**a**	12.5**b**	75.6**a**	12.2**b**	73.1**a**	96.7**c**	69.4**a**
TailW	8.6	8.4	9.8	5.7	5.4	7.1	6.7	6.2	9.1	4.1	9.5	4.4	8.1	4.2
TrunkL	44.1	46.3	47.3	29.0	32.0	36.4	37.0	35.0	46.1	23.6	43.5	26.5	45.5	26.1
HeadL	26.7	26.4	28.9	17.4	19.9	22.9	20.8	20.9	29.5	17.3	27.8	18.1	28.4	17.7
HeadW	19.1	18.1	20.7	12.6	13.1	16.1	15.1	14.9	20.1	12.0	19.6	11.6	20.2	11.9
HeadH	11.8	10.5	12.0	7.4	8.1	9.0	9.1	8.9	12.4	6.9	11.6	6.9	11.3	6.8
OrbD	6.6	6.1	7.0	4.2	5.2	5.9	5.4	5.2	6.2	4.2	6.8	3.5	6.1	3.8
EyeEar	7.1	7.3	8.7	4.9	5.7	6.8	6.8	5.8	8.9	5.3	7.4	4.7	8.6	5.0
SnEye	10.6	10.4	11.8	7.6	7.6	9.6	8.3	7.8	12.2	6.9	10.5	6.9	11.5	6.9
NarEye	8.0	7.6	8.7	4.9	5.0	6.4	5.9	5.4	7.8	4.7	7.3	4.7	8.3	4.2
Interorb	8.5	7.5	8.6	5.9	5.8	6.5	6.5	6.5	9.1	5.1	7.8	5.2	8.8	5.0
EarL	2.0	1.8	2.4	1.1	1.0	1.8	1.9	1.4	1.9	1.1	1.7	0.9	2.0	1.0
Internar	3.3	3.4	3.5	2.0	2.5	3.1	2.5	2.7	3.4	2.3	3.2	2.1	3.2	2.3

smaller (maximum SVL 79 mm fide Smith 1935) and has a much larger number of midventral scales (41–46 vs. 27–32).

DISTRIBUTION. — *Cyrtodactylus slowinskii* has thus far been recorded only from Alaungdaw Kathapa National Park in the Sagaing Division of Myanmar, where it appears to be both common and widespread. It is probable that the species is more widely distributed along the eastern foothills of the Rakhine Yoma (Arakan Yoma).

DISCUSSION

The affinities of *Cyrtodactylus brevidactylus* are unclear. Precloacal and femoral pore characteristics, although generally specifically stable, vary widely in the genus and are not obvious markers of interspecific affinities. *Cyrtodactylus brevidactylus* bears little resemblance to any of its congeners in respect to its rugose scalation and body shape. Likewise, its striking short digits are unique within the genus, although somewhat similar in proportion to those of some members of the Indian-Sri Lankan subgenus *Geckoella*, with which *C. brevidactylus* also shares a similar general habitus. The species is also very similar in body proportion to members of the Eublepharidae, although it lacks moveable eyelids and the osteological features (e.g., unpaired parietal bone) diagnostic of these gekkotans. Among regional geckos, its color pattern is most nearly approached by *C. angularis* and *C. papilionoides* of Thailand. These species share the small number of large, dark, dorsal blotches, but differ in the pattern of the dorsum of the head (see Chan-Ard et al. 1999, for color photographs of these and other Thai and Malaysian species of *Cyrtodactylus*).

Cyrtodactylus slowinskii is more typical of the genus in body form and superficially resembles other moderately large members of the genus. Its pattern of precloacal and femoral pores is shared with a number of geographically proximate congeners and it is probably allied to morphologically similar species such as *C. consobrinus*, although in the absence of a robust hypothesis of relationships, specific affinities remain conjectural at best.

Preliminary examination of additional collections from Myanmar suggests that at least two additional undescribed *Cyrtodactylus* are present, bringing the national total to twelve. The diversity of the herpetofauna of Myanmar has long been regarded as lower than that of surrounding areas. In large part this is due to the limited collecting activity in the country prior to the last several years (Inger 1999; Slowinski and Wüster 2000). Preliminary results of the on-going Myanmar Herpetofaunal Survey suggest that Myanmar is herpetogeographically complex, supporting taxa of both Indian and southeast Asian affinities, as well as endemics. Slowinski and Wüster (2000) described the Burmese spitting cobra (*Naja mandalayensis*) from the central dry zone of Myanmar and proposed that this region, lying between the Rakhine Yoma (Arakan Yoma) in the west and the extensive montane areas east of the Sittaung River (Fig. 3), would prove to be a significant area of endemism. The new *Cyrtodactylus* described herein support this proposition and the apparent restriction of *C. brevidactylus* to Mt. Popa further suggests that isolated physiographic features within the central dry zone may harbor endemics of their own.

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